

# ***Albert Einstein***

*Founder of Theory of Relativity*

*Subodh Mahanti*



**Vigyan Prasar**

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(An autonomous organisation under the Department of  
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C-24, Qutab Institutional Area

New Delhi 110 016

(Regd. Office : Technology Bhawan, New Delhi 110 016)

Phones : 26864157, 26864022 Fax : 26965986

E-mail : [vigyan@hub.nic.in](mailto:vigyan@hub.nic.in)

Internet : <http://www.vigyanprasara.com>

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## ***The World Year of Physics***

The Year 2005 has been designated the “World Year of Physics” by United Nations coinciding with the centenary of the enunciation of the Theory of Relativity. Albert Einstein’s seminal paper entitled “On the Electrodynamics of Moving Bodies” appeared in *Annalen der Physik* in 1905. It was a breakthrough in the history of physics centuries after Isaac Newton enunciated the laws of motion and the law of universal gravitation. Theory of Relativity—special and general—has stood the test of time for a century now, and remains one of the greatest creations of human mind that helps us understand nature in the proper perspective.

The year 2005 not only marks the centenary of the Theory of Relativity, it also marks the centenary of the Golden Decade 1895 – 1905 in which momentous discoveries in physics were made, say, for example; X-rays in 1895, Radioactivity and Zeeman Effect in 1896, the Electron in 1897, Quantum Theory in 1900 and explanation of Photoelectric Effect and Relativity in 1905. This period also witnessed the first trans-Atlantic telegraphic radio transmission and the existence of ionosphere. Surely, Theory of Relativity is a feather in the cap of discoveries made in this decade. Individually, each discovery had enormous significance, while collectively; they heralded what we today call “Modern Physics”.

The practitioners of classical physics of that period claimed that all the great discoveries had already been made and the physics would be reduced merely to measurements of greater and greater accuracy. Surely, a few discoveries did lie in the next decimal place as revealed by the discovery of argon during very accurate measurements of the constituents of air. The enormous advances around 1895 brought into question or directly contradicted theories that appeared to have been strongly supported by experimental evidence. For example, the experiments of Hertz demonstrated, beyond doubt, the fundamental nature of Maxwell’s electromagnetic theory of light.

Yet, by an irony of fate, these very experiments of Hertz brought to light the new phenomenon of the photoelectric effect, which played an important role in establishing the Quantum Theory.

There is no story more fascinating, enlightening, and inspiring than an account of the events and the people who made the fundamental discoveries possible during the decade 1895 – 1905. A peep in the lives of these makers of modern science, their approach and methods, dedication and sacrifice with an ardent desire to share their knowledge with others, provides an insight into the process and methodology of science. The discovery of Radioactivity by Becquerel is a beautiful example of the scientific method at work – that goes on to show that discovery is more of a process rather than an event.

Mentioned above are only a few pages from the history of science and technology that has shaped our present day lives. This story is inspiring and enlightening, not only for scientists but also for the common man. Recognition did not come instantaneously to them. They had their own share of misfortune and failures. But a trait common to all of them was a positive approach and a scientific outlook in whatever they did.

Celebrating the Year of Physics is, therefore, celebrating 100 years of the golden decade, and offers a great opportunity to communicate the basic scientific aspects of these discoveries and how they have shaped our lives, promote the method of science, and spread a scientific outlook among the people. Numerous programmes, conferences, and festivals would be organized the world over to celebrate the “World Year of Physics”. Vigyan Prasar (VP) has planned activities built around the work and lives of the makers of modern physics in collaboration with NCSTC and other agencies. Also planned is a variety of software – publications, films, radio and TV programmes, CD - ROMs, and slide shows; and resource material for training programmes of resource persons.

**New Delhi**  
**January 27, 2005**

**Dr. V.B. Kamble**  
**Director**  
**Vigyan Prasar**

# ***Albert Einstein***

## ***Founder of Theory of Relativity***

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*A man can do as he will, but not will as he will*

*Arthur Schopenhaur (1788-1860), the German Philosopher*

*For the most part, I do the thing which my own nature drives me to do. It is embarrassing to earn so much respect and love for it.*

*Albert Einstein*

*"One thing I have learned in a long life: that all our science, measured against reality, is primitive and childlike—and yet it is the most precious thing we have."*

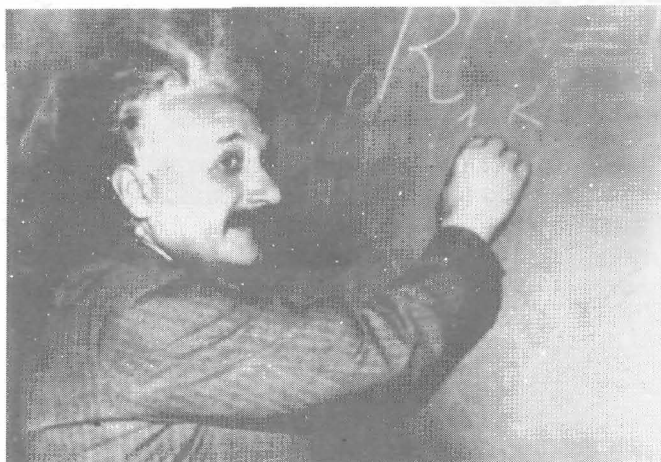
*Albert Einstein*

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Einstein contributed more than any other scientist to the 20<sup>th</sup>-century vision of physical reality. In fact he contributed more than any other scientist since Sir Isaac Newton to our understanding of physical reality. In 1905 Einstein proposed his theory of relativity. While proposing this theory, Einstein discarded the concept of time and space as absolute entities, as they were regarded till then. In the same year he explained the phenomenon of photoelectric effect by postulating light quanta or photons comparable to energy quanta. In 1916 Einstein published his theory of general relativity considered by many physicists as the most elegant intellectual achievement of all time. It had vast implication especially on the cosmological scale. Einstein forever changed the way we contemplate the universe. Einstein was more than a scientist, more

than a philosopher, and more than a world statesman. Einstein lived by a deep faith but then his was not a life of prayer and worship. His life-long pursuit was to discover the laws of Nature, to cultivate the fruit of pure learning.

Einstein's life and his work have been well chronicled. In fact there is hardly any other scientist on whom so much has been written or who has received such public attention. The first scientific subjects that the newly emerging mass media of the 1930s tried for popularization were Einstein's theories of relativity. But the media found it extremely difficult to make people understand what Einstein had to say. This is because even the simplest explanations of the theories were counterintuitive and were hard to follow. But the media did not leave at that. Instead of Einstein's work, the media concentrated on Einstein, the person. The media hype on



*Albert Einstein*

Einstein created something of a creature, which became the popular image of a modern scientist. Einstein became a peerless myth. Many people think that they understand Einstein's work but in reality they are familiar with the image of Einstein created by the media. In 1931 Einstein and Charlie Chaplin traveled together to Los Angeles to view the opening of the film "City Lights". They were recognised by the crowd and enthusiastically greeted. On this occasion, Chaplin noted: "The people applauded you (Einstein) because no one understands you, and me, because everyone understands me." What Chaplin said is largely true even today. Not many people really understand what actually Einstein did. In

fact many physicists themselves may not be in a position to fully grasp Einstein's work and what to talk about laypersons. The statement, "In the last analysis, fame is only the epitome of all the misunderstandings which gather about a new name" by Rainer Maria Rilke is very true for Einstein. Even Einstein did not understand why he was so well liked but at the same time so little understood. By writing this it is not intended to mean that Einstein's work cannot be understood but it is to highlight the fact that one needs a thorough background in physics and mathematics to understand Einstein's work.

Einstein was born in a small town named Ulm in Germany on 14 March 1879 to Hermann and Pauline Einstein. The family moved to Munich when Einstein was an infant. At Munich, Hermann Einstein and his brother Jakob Einstein established a small electrical plant and engineering works. The family later moved to Milan. The business activities of Einstein's father were never very successful. Like in many other cases, there was no early indications of Einstein's genius. He did not begin to talk until the age of three and he was not fluent till the age of nine. Einstein received his first instruction at home from a woman teacher, when he was five year old. At the same time



*Albert Einstein*

he started taking lesson on the violin. He entered the public primary school (called Volksschule in Germany) at the age of seven. There is a popular myth that Einstein was a poor student in his early years. It is not true. His grades were excellent and he was consistently placed at the top of the class. He did not always get along with his teachers at primary school. He did not like the rigid discipline and the rote-learning techniques. Einstein was a quite child. He had a natural antipathy for sports or outdoor activities. He made few friends at school and felt isolated and alone. He did not enjoy in playing with his classmates. He did not even join other children for playing at home. Instead he preferred solitary games

that required patience and persistence. His sister Maja wrote: "The children of family and relatives often got together in his parents' garden in Munich. Albert refrained from joining their boisterous games, however, and occupied himself with quieter things. When he occasionally did take part, he was regarded as the obvious arbiter in all disputes. Since children usually retain a very keen and unspoiled instinct for the exercise of justice, the general recognition of his authority indicates that his ability to think objectively had developed early." Among his favourite games was building a house of cards. However, his major recreational interest was music. Since his early childhood Einstein was taught to become self-reliant. Thus his sister wrote: "The boy was trained



*Pauline Einstein*

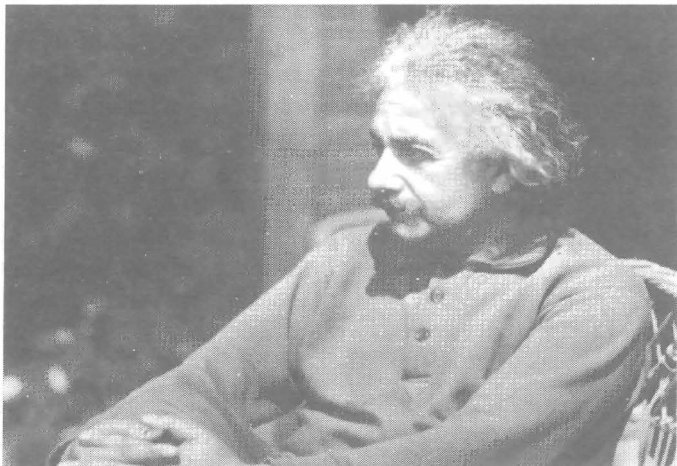


*Hermann Einstein*

*Einstein's Parents*

early in self-reliance, in contrast to the customary European child-rearing method which consists of over-anxious tutelage. The 3- or 4-year old was sent through the busiest streets of Munich; the first time he was shown the way, the second, unobtrusively observed. At intersections he conscientiously looked right, then left, and then crossed the road without any apprehension. Self-reliance was already ingrained in his character and manifested itself prominently on various occasions in his later life". It may be noted here that the biographical sketch of Einstein written by his sister Maja Winteler-Einstein is the major source of information on their family and Einstein's early life.



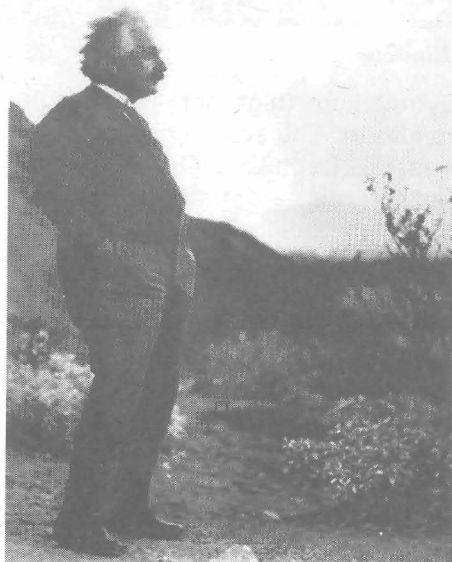


*Albert Einstein*

Einstein entered the Luitpold Gymnasium (high school) in 1888 and he studied here until he was fifteen. The school placed more emphasis on classical languages like Latin and Greek than to natural sciences. Einstein did well in Latin and mathematics, but he disliked the harsh and pedantic regimentation. To quote his sister Maja : "Actually, he was very uncomfortable in school. The style of teaching in most subjects was repugnant to him....The military tone of the school, the systematic training in the worship of authority that was supposed to accustom pupils at an early age to military discipline, was also particularly unpleasant for the boy. He contemplated with dread that not-too-distant moment when he would have to don a soldier's uniform in order to fulfill his military obligations. Depressed and nervous, he searched for a way out. Hence, when the professor in charge of his class (the same one who had predicted that nothing good would ever come of him) scolded him on some occasion, he obtained a certificate from the family doctor, presented it to the school principal and abruptly left to join his parents in Milan. They were alarmed by his high-handed behaviour, but he most adamantly declared that he would not return to Munich, and reassured them about his future by promising them most definitely that he would independently prepare himself for the entrance examination to the Zurich Polytechnical School in autumn. This was a bold decision for a 16-year-old, and he actually carried it out. His parents resigned themselves to the new situation with grave misgivings, but were persuaded to do all they could to further the plan."

In October 1895 Einstein took the Entrance examination to the prestigious Eidgenössische Technische Hochschule (the Federal Institute of Technology or ETH as it is usually referred to), in Zurich. Einstein failed the examination. He did quite well in science and mathematics but not well enough in languages, history, literature and art to qualify. This was a serious setback for Einstein. But considering his youth the school authorities took a lenient view. They told Einstein's parents that they would admit him after he attends the final year of a Swiss secondary school. Thus Einstein got enrolled in the Cantonal school in Aarau, a small Swiss town. The school had a high reputation. It attracted students even from overseas.

While in school, Einstein had decided to embark on a life-long study of the "huge world". He



*"What I see in Nature is a magnificent structure that we can comprehend only very imperfectly, and that must fill a thinking person with a feeling of humility. This is a genuinely religious feeling that has nothing to do with mysticism."*

would later say: "There was this huge world out there, independent of us human beings and standing before us like a great, eternal riddle, at least partly accessible to our inspection and thought. The contemplation of that world beckoned like a liberation." He also said: "I have never imputed to Nature a purpose or a goal, or anything that could be understood as anthropomorphic. What I see in Nature is a magnificent structure that we can comprehend only very imperfectly and that must fill a thinking person with a feeling of humility. This is a genuinely religious feeling that have nothing to do with mysticism."

Einstein often talked about one story about his childhood—it was of a wonder he saw when he was four or five years old, a magnetic compass. Einstein was profoundly impressed

by the needle's invariable northward swing, guided by an invisible force. By seeing it he was convinced that there must be "something behind things, something deeply hidden." Einstein learned geometry by himself before it was taught in class. He was impressed by geometry for its precision and definiteness. Einstein said: "At the age of 12, I experienced a wonder in a booklet dealing with Euclidean plane geometry, which came into my hands at the beginning of a school year. Here were assertions, as for example the intersection of the three altitudes of a triangle in one point, which—though by no means evident—could nevertheless be proved with such certainty that any doubt appeared to be out of question. This lucidity and certainty made an indescribable impression on me." He also studied differential and integral calculus on his own. Einstein's interest in mathematics was aroused and sustained by his uncle, Jacob Einstein. His sister Maja wrote: "In Gymnasium, the boy was supposed to begin the study of algebra and geometry at the age of 13. But by that time he already had a predilection for solving complicated problem in applied arithmetic,



*Albert Einstein*

although the computational errors he made kept him from appearing particularly talented in the eyes of his teachers. Now he wanted to see what he could learn about these subjects in advance, during his vacation, and asked his parents to obtain the textbooks for him. Play and playmates were forgotten. He set to work on the theories, not by taking their proofs from books, but rather by attempting to prove them for himself. For days on end he sat alone, immersed in the search for solution, not giving up before he found it. He often found proofs by ways that were different from those found in the books. Thus, during this one vacation of a few months, he independently worked his way through the entire prospective Gymnasium Syllabus. Uncle Jacob, who was an engineer had a comprehensive mathematical education, reinforced Albert's zeal



*Albert Eistein and his sister, Maja*

by posing difficult problems, not without good-natured expressions of doubt about his ability to solve them. Albert invariably found a correct proof; he even found an entirely original one for the Pythagorean theorem. When he got such results, the boy was overcome with great happiness, and was already then aware of the direction in which his talents were leading him."

Besides his uncle, Max Talmud, a medical student with little money, also influenced Einstein in his school days. Talmud used to take one evening meal each week with the Einsteins. Talmud used to give book on science and philosophy to young Einstein. The two used to discuss for hours together.

Einstein's power of mental concentration was proverbial. He could easily engross in deep thought in a corner of a noisy room. He could work without being disturbed by the conversations of others. Once Einstein said to one of his students: "I am always available to speak to you. If you have a question come to me

without worrying. You will never disturb me because I can always break off my work at any moment and return to it immediately after the interruption." One of his students actually witnessed how Einstein could concentrate without being disturbed by the surroundings. He described it in the following way: "He was sitting in his study in front of a heap of papers covered with mathematics formulae. Writing with his right hand and holding his younger son in his left, he kept replying to questions from his elder son Albert who was playing with his bricks. With the worlds, "Wait a minute, I am nearly finished," he gave me the children to look after for a few moments and went on working. It gave one glimpse of his immense powers of concentration."

Einstein graduated from the Swiss Polytechnic in the spring of 1900 as a secondary school teacher of mathematics and physics. After graduation his primary objective was to secure a job. He expected to get a position as teaching assistant but to his disappointment he did not get one. His disregard for authority in school and in college was responsible for his inability to secure a position. His mathematics teacher at the Polytechnic, Hermann Minowski, considered Einstein a "lazy dog" who seldom came to class. His other teachers did not hold good opinion of him. Heinrich Weber, his physics teacher at the polytechnic is supposed to have told him: "You are a smart boy. But you have one great fault, you do not let yourself be told anything." It is said that one of his teachers even suggested Einstein leave school, since his very presence destroyed the other students' respect for the teacher. So naturally his teachers refused to recommend him for a teaching position. Perhaps they thought that if he could not show enough enthusiasm for class work, he might not show it for professional work. After two years of struggling to eke out living as a tutor and substitute teacher, Einstein finally got a job. In June 1902 Einstein got an appointment, on a temporary basis, as a technical expert, third class, in the patent office in Berne, Switzerland. Einstein got this job through the efforts of his friend Marcel Grossman, whose father was a friend of the Director of the Swiss patent office. Einstein enjoyed his work at the patent office, where he worked from 1902 to 1909. Einstein wrote: "The work on satisfactory formulation of technical patents was a true blessing for me. It compelled me to be many-sided in thought, and also offered important stimulation for thought about physics. Following a practical profession is a blessing for people of my type. Because the academic career puts a young person in a sort of compulsory situation to produce

scientific papers in impressive quantity, a temptation to superficiality arises that only strong characters are able to resist."

Einstein's son-in-law Rudolf Kayser wrote: "Albert's work, though it was not too trying, was still a strain. He was not used to sitting eight hours over official duties which he could discharge with the some degree of faithfulness in three or four. He was much too young and too high-strung to perform his duties as slowly as the others. He soon discovered that he could find time to devote to his own scientific studies if he did his work in less time. But discretion was necessary, for though authorities may find slow work satisfactory, the saving of time for personal profit is officially forbidden. Worried, Einstein saw to it that the small sheets of paper on which he wrote and figured vanished into his desk-drawer as soon as he heard footsteps approaching behind his door."

While working at the Patent Office he completed an astonishing range of publication in theoretical physics. He had to do a lot of outside reading and analysis to keep up with modern physics. He worked in his spare time even during office hours as described by his son-in-law above. Einstein did not have the benefit of close contact with either the scientific literature or fellow scientists. In 1905 alone Einstein published four papers that changed the face of physics. These papers were to direct the progress of physics during the 20<sup>th</sup> century. Einstein achieved all this working alone in the backroom of his small apartment in Bern. Perhaps the only period in the entire history of physics comparable to this one is Isaac Newton's stay at Woolsthorpe during 1665-66. The four papers published by Einstein in 1905 were:

1. On the Motion of Small Particles Suspended in a Stationary Liquid According to the Molecular Kinetic Theory of Heat.
2. On a Heuristic Point of View about the Creation and Conversion of Light.
3. On the Electrodynamics of Moving Bodies.
4. Does the Inertia of a Body Depend on its Energy Content?

By seeing the titles of the papers a layperson would have no clue about their contents. Einstein's first paper, which he sent for publication in March 1905, was on Brownian motion, a phenomenon first described by Robert Brown in 1828. Einstein derived a formula for the average displacement of particles in suspension, based on the idea that a tiny particle in a fluid being constantly bombarded by surrounding molecules dart around in an erratic movement.

Jean Perrin confirmed Einstein's formula in 1908. It represented the first direct evidence for the existence of atoms and molecules of definite sizes and thus he put an end to a millennia-old debate on the fundamental nature of chemical elements.

The second paper was on photoelectric effect. In this paper he gave a new understanding of light. Einstein proposed that light could act as though it consisted of discrete, independent particles of energy, in some ways like particles of a gas. It may be noted that Max Planck had earlier suggested discreteness in energy. Einstein showed light quanta or the particles of energy could explain many phenomena studied by experimental physics, for example ejection of electrons from metals by light. Einstein's theory of light formed the basis for much of quantum mechanics.

In the third paper Einstein first time introduced the concept of theory of relativity. It was called 'special' theory of relativity because the theory is restricted to certain special circumstances like bodies at rest or moving with uniform relative velocities. It should be noted that the special theory of relativity does not state that everything in the universe is relative. It stated that time and space (which were thought to be absolute) are relative and the speed of light is absolute. The special theory of relativity had a number of seemingly unusual consequences:

- i. The length of a body along its direction of motion decreases with increasing velocity.
- ii. The mass increases as the velocity increases. And at the speed of light the mass of a body becomes infinite.
- iii. Time slows down for a moving body.

In his fourth paper Einstein reported a remarkable consequence of his special theory of relativity—if a given body emits a certain amount of energy, then the mass of that body must decrease by a proportionate amount. Einstein concluded that if a body gives off energy ( $E$ ) in the form of radiation, its mass ( $m$ ) diminishes by  $E/c^2$ , where  $c$  is the velocity of light. He thus derived the equation  $E=mc^2$ , which unifies the concepts of matter and energy. It is certainly the best-known equation of all time. This equation accounts for the thermonuclear processes that empower the stars and it also accounts for the explosive power of the atomic bomb.

Even after publishing such papers having far reaching implications, Einstein did not get an academic appointment easily. In 1907 Einstein applied for a position of a Privatdozent, an



untrained lecturer, at Berne University. A Privatdozent, however, was an official member of university who could give lectures on a subject of his choice, charging students a fee to attend. Einstein's application was turned down. It is said that one of the reasons for turning down his application was that the head of the department of physics of the Berne University termed Einstein's papers on special theory of relativity as 'incomprehensible'. The next year he finally got a position of a privatedozent. But Einstein could not afford to resign from the patent office, as his position at the University did not carry any regular salary. His first lectures as a member of the university delivered in the winter of 1908/9 were not well-attended. However, within a short time Einstein's work on relativity was widely recognized to be original and profound. And then there was no dearth of important academic appointments.

After two years of publication of his special theory of relativity, Einstein started thinking of extending this theory to frames of reference, which are being accelerated with respect to one another. By doing this restrictions imposed on the special theory of relativity would be removed. Einstein realized that on certain assumptions, accelerated motion could be incorporated into his new, general theory of relativity. The main consequences of the general theory of relativity are:

- i. Gravity and inertia are two different words of the same thing.
- ii. While thinking about space, four dimensions must be considered—length, width, height, and time. Every event that takes place in the universe is an event occurring in four-dimensional world of space and time.
- iii. Space-time is curved or warped by the presence of large masses like the Sun.
- iv. Light would bend as it passes a large body like the Sun. Einstein had predicted in 1911 that starlight just grazing the Sun should be deflected by 1.7 minute of arc. During a total solar eclipse of the Sun, Eddington measured this and the deflection measured by him was 1.61 minute of arc.

In 1919, when a student asked Einstein what would happen if the general theory of relativity was not validated by experimental measurement, Einstein replied: "I would have felt sorry of the dear Lord, because the theory is correct." Early in the twenties, Einstein started working on the unified field theory, which engaged his attention till the very end.



Einstein was awarded Nobel Prize in 1922. Interestingly he was given Nobel Prize for his contribution to mathematical physics and particularly for his discovery of the photoelectric effect. Einstein did not attend the award giving ceremony as he was on voyage to Japan. He did not mention it in his diary or in his letters to friends. It is said that he even forgot to include it on a form listing honors he had received. However, it is interesting to note that when he divorced his first wife, Mileva, he had promised her the Nobel Prize money as alimony.

Einstein was not a mere pure abstract thinker. He tried to visualize the physical universe in concrete images. To quote Einstein: "The words or the language, as they are written or spoken, do not seem to play role in my mechanism of thought. The physical entities which seem to serve as elements in thought are certain signs and more or less clear images which can be "voluntarily" reproduced and combined. The above-mentioned elements are, in my case, of visual and some of muscular type. Conventional words or other signs have to be sought for laboriously only in a secondary stage, when the mentioned associative play is sufficiently established and can be reproduced at will."

One common myth about Einstein is that he played a prominent role in making the atom bomb. In fact many consider Einstein as the father of the atom bomb. There are two apparent reasons for this kind of belief. First people think that his famous equation  $E=mc^2$  has something to do with the atom bomb. Second Einstein wrote a letter to the US President Roosevelt. But the truth is that Einstein had no direct role in the atom bomb project. Explaining his role Einstein wrote: "My part in producing the atomic bomb consisted in a single act: I signed a letter to President Roosevelt pressing the need for experiments on a large scale in order to explore the possibilities for the production of an atomic bomb. I was fully aware of the terrible danger to mankind in case this attempt succeeded. But the likelihood that the German were working on the same problem with the chance of succeeding forced me to this step. I could do nothing else, although I have always been a convinced pacifist. To my mind, to kill in war is not a whit better than to commit ordinary murder. As long, however, as nations are not resolved to abolish war through common action and to solve their conflicts and protect their interests by peaceful decision on a legal basis, they feel compelled to prepare for war. They feel obliged to prepare all possible means, even the most detestable ones, so as not to be left behind in the general armament race."

Einstein worked for the world peace. He took up many social issues. But at the same time he did not feel strongly for direct contact with other human beings or communities. He built his inner equilibrium not upon the foundation of personal relationships but upon the foundation of his quest for understanding the laws of Nature. He once said: "My passionate sense of social justice and social responsibility has always contrasted oddly with my pronounced lack of need for direct contact with other human beings and human communities. I am truly a "lone traveler" and have never belonged to my country, my home, my friends or even my immediate family with my whole heart; in the face of all these ties, I have never lost a sense of distance and a need for solitude – feelings which increase with the years. One becomes sharply aware, but without regret, of the limits of mutual understanding and consonance with other people. No doubt, such a person loses some of his innocence and unconcern, on the other hand, he is largely independent of the opinions, habits, and judgement of his fellows and avoids the temptation to build his inner equilibrium upon such insecure foundations".

Einstein studied philosophy in great detail. He was fully convinced that science, mathematics and technology not only needed to be balanced with philosophy, ethics, spirituality, and the arts, but they were merely "different branches of the same tree." Einstein said: "All religions, arts and sciences are directed toward ennobling man's life, ennobling it from the sphere of mere physical existence and leading the individual toward freedom." Further according to Einstein: "Both churches and universities—insofar as they live up to their true function—serve the ennoblement of the individual. They seek to fulfill this great task by spreading moral and cultural understanding, renouncing the use of brute force." Einstein was deeply concerned with the way education is imparted in schools. He was of the opinion that a school's main goal always be to produce individuals who are "harmonious personalities", not specialists. He said: "... I want to oppose the idea that the school has to teach directly that special knowledge

A black and white photograph of Albert Einstein's handwritten signature. The signature is written in a fluid, cursive script, starting with a large 'A' and ending with a long, sweeping flourish that extends to the right. The ink is dark and the background is a light, textured surface.

and those accomplishments, which one has to use later directly in life. The demands of life are much too manifold to let such a specialized training in school appear possible. Apart from that, it seems to me, moreover, objectionable to treat the individual like a dead tool. The school should always have as its aim that the young person leave it as a harmonious personality, not as a specialist. This in my opinion is true in a certain sense even for technical schools, whose students will devote themselves to a quite definite profession. The development of general ability for independent thinking and judgment should always be placed foremost, not the acquisition of special knowledge. If a person masters the fundamentals of his subject and has learned to think and work independently, he will surely find his way and besides will be better able to adapt himself to progress and changes than the person whose training principally consists in acquiring of detailed knowledge."

In 1940 Einstein became a citizen of the United States but he retained his Swiss citizenship. In 1994 he prepared a hand-written version of his 1905 paper on special theory of relativity and put it on auction for contributing to the war effort. It could raise six million US dollar. The manuscript subsequently found its place in the US Library of Congress. In 1952 Einstein was offered the Post of the President of Israel. He was to become the second president of Israel but he declined the offer.

Einstein died on 18 April 1955. He was cremated at Trenton, New Jersey. In his last letter, which he wrote to Bertrand Russel, one week before his death, Einstein agreed that his name should go on a manifesto urging all nations to give up nuclear weapons. He worked till the very end. Abraham Pais, who has written a scientific biography of Einstein, records that the day before Einstein died, he was studying the most recent pages of his calculations on the unified field theory.

We would like to end this article by quoting what Einstein had to say to school students: "Bear in mind that the wonderful things you learn in your schools are the work of many generations, produced by enthusiastic effort and infinite labour in every country of the world. All this is put into your hands as your inheritance in order that you may receive it, honour it, add to it, and one day faithfully hand it on to your children...If you always keep that in mind you will find a meaning in life and work and acquire the right attitude toward other nations and ages."

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